

AAMRL-TR-86-029

AD-A173 193

A NINE-SIZE SYSTEM FOR CHEMICAL DEFENSE GLOVES

KATHLEEN M. ROBINETTE

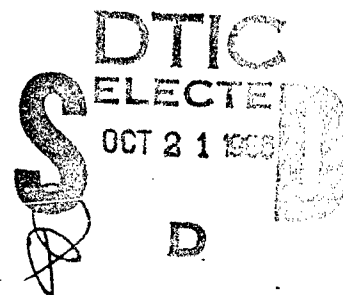
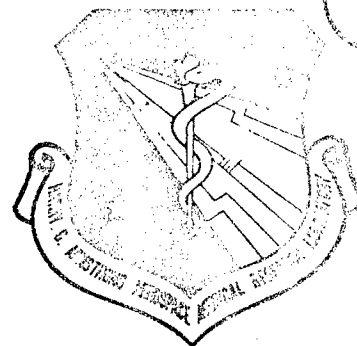
HARRY G. ARMSTRONG AEROSPACE MEDICAL RESEARCH LABORATORY

JAMES F. ANNIS

ANTHROPOLOGY RESEARCH PROJECT, INC.

JULY 1986

20030121171



DTIC FILE COPY

Approved for public release; distribution unlimited.

HARRY G. ARMSTRONG AEROSPACE MEDICAL RESEARCH LABORATORY
AEROSPACE MEDICAL DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-6573

86 10 21 037

AD-A173193

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION/AVAILABILITY OF REPORT	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE			
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AAMRL-TR-86-029		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION Armstrong Aerospace Medical Research Laboratory	6b. OFFICE SYMBOL (If applicable) HEG	7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State and ZIP Code) Wright-Patterson Air Force Base, Ohio 45433-6573		7b. ADDRESS (City, State and ZIP Code)	
8a. NAME OF FUNDING/SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
9c. ADDRESS (City, State and ZIP Code)		10. SOURCE OF FUNDING NOS.	
		PROGRAM ELEMENT NO.	PROJECT NO.
		TASK NO.	WORK UNIT NO.
11. TITLE (Include Security Classification) A NINE-SIZE SYSTEM FOR CHEMICAL DEFENSE GLOVES		62202F	7184
		08	42
12. PERSONAL AUTHOR(S) Robinette, Kathleen M. and Annis, James F.			
13a. TYPE OF REPORT Technical	13b. TIME COVERED FROM TO	14. DATE OF REPORT (Yr., Mo., Day)	15. PAGE COUNT 45
16. SUPPLEMENTARY NOTATION Anthropology Research Project, Inc. 503 Xenia Avenue Yellow Springs, Ohio 45387			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB. GR.	
		Anthropometry Chemical Defense	
		Hands Gloves	
		Sizing	
19. ABSTRACT (Continue on reverse if necessary and identify by block number)			
<p>The purpose of this effort was to meet the need for improved sizing of chemical defense (CD) gloves for Air Force men and women. A nine-size system was developed from available hand data. The development process and size values are presented in this report. Some summary statistics and regression equations are provided to aid investigators who may wish to make modifications.</p> <p>Although the sizing system outlined in this report is statistically sound, it is experimental. The authors recommend that anthropometric fit-testing be conducted prior to full-scale glove production.</p>			
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS <input type="checkbox"/>		21. ABSTRACT SECURITY CLASSIFICATION	
22a. NAME OF RESPONSIBLE INDIVIDUAL KATHLEEN M. ROBINETTE		22b. TELEPHONE NUMBER (Include Area Code) (513) 255-8810	22c. OFFICE SYMBOL AAMRL/HEG

SUMMARY

Ongoing studies at the Armstrong Aerospace Medical Research Laboratory of the effects of chemical defense gloves on dexterity and performance indicate the need for improved sizing. This is particularly true with regard to the smaller hand sizes required by many women. The present program was undertaken in order to provide designers of gloves and hand forms with data which incorporate the range of size variability of Air Force men and women into a single system. The report details the development of a nine-size, integrated system which provides design values for 22 hand dimensions and two dimensions taken from current Department of Defense hand forms.

Data for two slightly different nine-size systems are presented: one is for gloves to be worn directly on the bare hand and the other is for gloves worn over a typical liner. The latter includes increments in appropriate dimensions to permit accommodation of the liner inside the glove. Both systems include two sizes which are based exclusively on female data, two sizes which are integrated, and five sizes which are exclusively male in origin. The nine sizes involve three hand length brackets and four hand circumference brackets to cover approximately 95% of the distribution of male and female hand sizes. The dimensions hand length and hand circumference were used as key dimensions in developing the system. The remaining 20 hand dimensions were derived through use of regression equations specific to each variable. The equations used the key dimensions as the independent variables to predict the values for each size category. In most cases the midpoint values of the key dimensions for each size category were used in the equations to generate the design values. The basis for this maneuver and the exceptions are described in the text.

The proposed nine-size systems resulted from the anthropometric sizing analysis of proposed six- and 11-size systems. The selection of nine sizes is felt by the authors to represent the best compromise from the standpoint of costs, logistics, and fit sensitivity. Details of the background studies are to be the subject of a future report. The current report, in addition to the basic design values, presents an outline of the anthropometric sizing process, information on the statistical derivation and use of sizing values, and copies of the pertinent printouts produced by our sizing program for each sex. The designer may, by study of the information provided, modify the proposed values or even develop an entirely new system.

Accession For	
NTIS	CRA&I
DTIC	TAB
Unannounced	
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail. or Special
A-1	

PREFACE

This research was carried out by the Anthropology Research Project, Inc. under Air Force Contract F33615-82-C-0510 (Project 718408) with the Harry G. Armstrong Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

The authors would like to thank ASD/AEPF and ASD/AESD for their support of this effort. We would also like to thank Donna Bagdonovich of the U.S. Army STRNC-ICCH, and Dr. Claire Gordon of the U.S. Army, DRDNA-ICCH for their constructive comments during sizing development.

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
INTRODUCTION	7
DEVELOPING AN ANTHROPOMETRIC SIZING PROGRAM	7
SELECTION OF THE SIZING SAMPLE	8
SELECTION OF KEY DIMENSIONS	10
ESTABLISHMENT OF SIZING INTERVALS	10
DEVELOPMENT OF DESIGN DATA	13
Procurement Tariff	24
APPENDIX A: Methods and Procedures for Computation and Use of Sizing Values	25
APPENDIX B: Sizing Data for the Nine Size Categories	31
REFERENCES	41

LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
1	Dimensions used for the glove sizing system	11
2	Relationship of the nine glove sizes to hand circumference at metacarpale and hand length for Air Force men and women	14
A-1	Normal distribution indicating approximate population percentiles with specified standard deviations (SD)	29

LIST OF TABLES

<u>Table</u>		
1	Comparison of Selected Garrett Values With Major Air Force Survey Values	9
2	Variation in Midsize Values for Males and Females for Sizes to be Integrated	17
3	Design Values for Gloves to be Worn Over Bare Hands	18
4	Sizing Values for Gloves to be Worn Over Liners	21
5	Estimated Tariff for the Nine-size System	24
A-1	Summary Statistics and Regression Equations for the Twenty-Two Hand Dimensions - Females	27
A-2	Summary Statistics and Regression Equations for the Twenty-Two Hand Dimensions - Males	28
	Sizing Data for the Nine Size Categories:	
B-1	Short Small	32
B-2	Regular Small	33

LIST OF TABLES (cont'd)

<u>Table</u>		<u>Page</u>
	Sizing Data for the Nine Size Categories:	
B-3	Short Medium	34
B-4	Short Large	35
B-5	Regular Medium	36
B-6	Regular Large	37
B-7	Regular X-Large	38
B-8	Long Large	39
B-9	Long X-Large	40

A NINE-SIZE SYSTEM FOR CHEMICAL DEFENSE GLOVES

INTRODUCTION

The cliché "fits like a glove" may carry the connotation that the design and sizing of gloves is an exact science that has long been perfected. However, in manual tasks requiring even reasonable levels of dexterity and tactility, performance by the gloved hand has repeatedly been shown to suffer by comparison with bare-handed performance. Ongoing studies at the Armstrong Aerospace Medical Research Laboratory (AAMRL) show that this is particularly true of chemical defense (CD) gloves (Robinette, Ervin and Zehner, in press). For a given task, the magnitude of performance decrements depends on the type, style and quality of fit of the gloves worn.

With the object of improving the quality of fit of chemical defense gloves, anthropometric sizing techniques were used to develop new sizing systems. A series of analytical steps using hand anthropometry from selected U.S. Air Force (USAF) samples was undertaken to derive design values for a variety of important hand dimensions. Sizing systems containing from six to 11 size categories were examined with a view toward accommodating approximately 95% of the hand size variability in the current male/female Air Force population. Results of the investigation indicate that integrated male/female glove sizing systems using nine size categories appear to offer the best compromise between the costs and logistics of manufacture and procurement and the need to achieve a desirable level of fit sensitivity.

Anthropometric design values for two slightly different nine-size programs are presented. The first provides values related to bare hand dimensions; the second provides modified values which include an increment for gloves to be worn over typical glove liners. Both may be used to guide the design of three-dimensional hand forms used in the manufacture of gloves. This report details the process used in the development of these size systems and provides size-specific values for 22 hand dimensions and two hand form dimensions for use by glove designers.

DEVELOPING AN ANTHROPOMETRIC SIZING PROGRAM

An anthropometric sizing analysis for clothing and personal protective equipment is based on the concept of dividing the population into subgroups of individuals who are more or less similar in certain relevant body size dimensions and then analyzing the anthropometric data for these subgroups to arrive at appropriate dimensional design values which will accommodate the size variability within each group. Specifically, the sequence of steps involved is:

- I Selection of the appropriate body of data for analysis.
- II Selection of one or more key or basic sizing dimensions.

III Determination of the range of the key dimension(s) and establishment of sizing categories that will adequately accommodate nearly 95% of the population.

IV Development of all other dimensional data to be used in the design and sizing of the item for each size category.

This approach has proved to be effective on past occasions (McConville and Alexander, 1975; Robinette, Churchill and Tebbetts, 1981) but no anthropometric sizing program can be considered completely successful without fit-testing of prototype items. While the first two steps outlined above are usually quite straightforward, the latter two involve some educated but intuitive judgments. Any discrepancies between the theoretical and the fit of the end product which result from these judgment calls can be identified by careful fit-testing. The working data provided in this report for each size category can be used to make needed design and/or sizing modifications if they are indicated. Anthropometric fit-testing is therefore recommended as a final "step" in the development of this sizing program.

SELECTION OF THE SIZING SAMPLE

The first task is to select an appropriate sizing sample. Hand measurements in the major U.S. military anthropometric surveys are generally few in number. In examining holdings in the AAMRL anthropometric data bank (Churchill, Kikta and Churchill, 1977), it was found that the numbers of hand dimensions, including wrist circumference, measured in the larger Air Force (AF) surveys were as follows:

<u>Men</u>	<u>Women</u>
1950 AF Flyers 11	1968 AF Women 4
1965 AF Personnel. 8	
1967 AF Flying Personnel 8	

These are too few variables to receive serious consideration for use as a sizing base, and even this number would not be available for analysis because of the requirement that only those which appear in both male and female studies and are comparably measured in both can be used in a sizing analysis. In addition, little, if any, data are provided to describe finger size which is considered to be vital to the development of any glove sizing program.

The only data known to include the desired listing of variables are those reported by Garrett (1970a, 1970b) for Air Force men and women. Although the samples were relatively small (n=148 and 211 for the men and women, respectively) a total of 56 dimensions was reported. The measurement methods employed in these surveys are described in the publications referenced above.

Garrett concluded that his samples adequately reflected the hand-size distributions of Air Force personnel as the result of a comparison of his means

and standard deviations with those obtained in the much larger USAF surveys. A similar comparison is shown in Table 1.

TABLE 1
COMPARISON OF SELECTED GARRETT VALUES
WITH MAJOR AIR FORCE SURVEY VALUES
(values in inches)

<u>FEMALES</u>					
<u>Dimensions</u>	Garrett (n=211)		1968 AF Women (n=1905)		<u>Diff.*</u>
	<u>Mean</u>	<u>SD</u>	<u>Mean</u>	<u>SD</u>	
Hand Length	7.06	0.34	7.24	0.38	-0.18
Hand Circ	7.37	0.33	7.21	0.36	0.16
Hand Breadth	3.04	0.15	2.97	0.15	0.07

<u>MALES</u>					
	Garrett (n=148)		1965 AF Men (n=3869)		
Hand Length	7.76	0.37	7.74	0.39	0.02
Hand Circ	8.50	0.35	8.46	0.41	0.04
Hand Breadth	3.53	0.16	3.49	0.19	0.04

* Garrett's mean value minus major survey mean value.

As a subset of the 1968 Air Force women's survey, Garrett's females were selected to provide a distribution similar to that observed in the larger population. However, the smaller population appears to be slightly shifted toward shorter hand lengths, larger hand circumferences and larger hand breadths. These differences should have no undue effect in practical application. There are no significant differences ($\alpha = .01$) between the Garrett males and the 1965 USAF males for hand length, circumference or breadth.

Although very few hand dimensions were measured in the major USAF surveys, the data were used in the sizing analysis in several ways: they influenced the choice of key sizing dimensions (Step II), and they were used to study the basic hand size distribution of USAF personnel and to establish the size categories (Step III). These large-survey data were also used to arrive at tariff estimates--that is, numbers of each size required (see Procurement Tariff). Because the 1965 survey represents the best sampling of Air Force male CD glove users, it and the 1968 Air Force women's survey were selected for use in this analysis.

The smaller Garrett surveys, with their wealth of hand dimensions, were used to develop the actual design data (Step IV). Hence, these samples represent the sizing data base. Of the 56 dimensions available in the base studies, 18 deemed most useful to glove designers were selected for the final sizing analysis. These are illustrated in Figure 1. Also shown in Figure 1 are four curved-finger dimensions (19-22) adapted from the original data (see Appendix A), and two additional dimensions (23,24) taken from the current Department of Defense hand form.

SELECTION OF KEY DIMENSIONS

The selection of one or more key (sizing) dimensions involves both practical and statistical considerations, both of which played a part in selecting hand length and hand circumference (measured at the metacarpal-phalangeal joint) for the glove sizing system presented here. On the practical side, key dimensions which are used to determine what size an individual will wear should be measurements which are easily taken and reliably repeatable. The object is to make it as simple as possible to assign sizes after the gloves are developed. Hand length and hand circumference meet this requirement, and were available in all four of the surveys which were used in the analysis: Garrett's (1970a and 1970b) female and male studies, and the major 1965 (Kennedy, 1986) and 1968 (Clauser et al., 1972) surveys. In addition, statistically, these variables in combination have a strong relationship with most of the other important variables of interest, which is an important attribute of sizing dimensions.

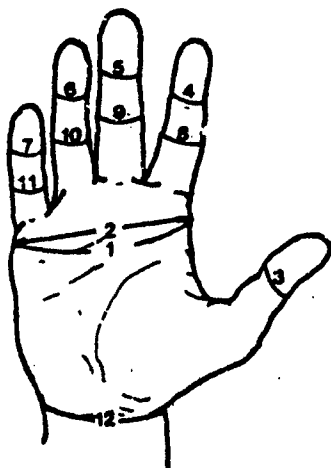
ESTABLISHMENT OF SIZING INTERVALS

The number of sizes required to accommodate 90-95% of a given population is controlled in large measure by the key dimension intervals--that is, the differences between sizes. There is no clear-cut rule to govern the magnitude of the intervals selected; however, as with key dimension selection, both practical and statistical aspects must receive consideration.

Past glove sizing systems using hand length and hand circumference as key dimensions have used various interval ranges (Barter and Alexander, 1956), but no previous system integrated the range of variation in male and female hands into a single sizing system. The total range of variation for a given dimension is not doubled by inclusion of both sexes in the system; however, if the same intervals used in previous male-only sizing systems were used for an integrated system, an impractically large number of sizes would probably be indicated.

A variety of schemes, ranging from six to 11 sizes, was examined. The key dimension intervals per size category which were tested ranged from 0.25 to 1.0 inch/size for length, and from 0.40 to 1.5 inch/size for circumference. Details of this investigation and other technical information regarding sizing analysis in general are to be the subject of a future report.

Ultimately, a nine-size program, incorporating 0.75-inch intervals for both hand length and hand circumference, was selected to be the optimum choice with

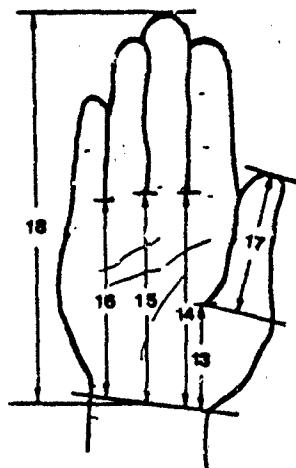


- 1 Hand Circumference at Metacarpale
- 2 Hand Breadth at Metacarpale
- 3 Digit Joint Circumference*
- 4 Digit 2 Distal Joint Circumference*
- 5 Digit 3 Distal Joint Circumference*
- 6 Digit 4 Distal Joint Circumference*
- 7 Digit 5 Distal Joint Circumference*
- 8 Digit 2 Proximal Joint Circumference*
- 9 Digit 3 Proximal Joint Circumference*
- 10 Digit 4 Proximal Joint Circumference*
- 11 Digit 5 Proximal Joint Circumference*
- 12 Wrist Circumference

* Digit circumferences were not directly measured in the sizing base samples. Values were calculated from the depth and breadth measurements at the joint centers using the formula:

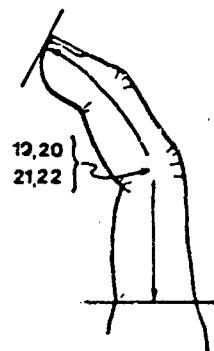
$$C = 2\pi \sqrt{\frac{a^2 + b^2}{2}}$$

where a and b equal one half the depth and breadth values.

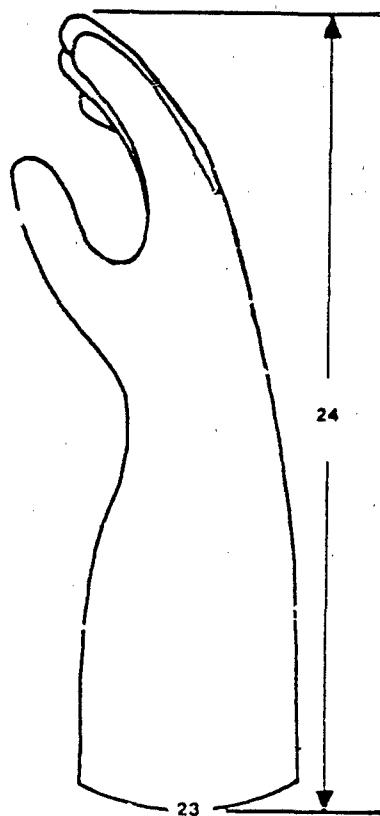


- 13 Crotch 1 Height
- 14 Crotch 2 Height
- 15 Crotch 3 Height
- 16 Crotch 4 Height
- 17 Digit 1 Tip-Crotch
- 18 Hand Length

Figure 1. Dimensions used for the glove sizing system.



- 19 Digit 2 Tip-Crotch
- 20 Digit 3 Tip-Crotch
- 21 Digit 4 Tip-Crotch
- 22 Digit 5 Tip-Crotch



- 23 Base Circumference
- 24 Total Length

Figure 1. (cont'd)

regard to both practical consideration and good fit. The size categories are as follows:

<u>Size</u>	<u>Name</u>	<u>Symbol</u>	<u>Hand Length Range</u>	<u>Hand Circumference Range</u>
			(inches)	(inches)
1	Short Small	SS	6.50-7.25	6.50-7.25
2	Short Medium	SM	6.50-7.25	7.25-8.00
3	Short Large	SL	6.50-7.25	8.00-8.75
4	Regular Small	RS	7.25-8.00	6.50-7.25
5	Regular Medium	RM	7.25-8.00	7.25-8.00
6	Regular Large	RL	7.25-8.00	8.00-8.75
7	Regular X-Large	RXL	7.25-8.00	8.75-9.50
8	Long Large	LL	8.00-8.75	8.00-8.75
9	Long X-Large	LXL	8.00-8.75	8.75-9.50

These same size categories are depicted in the simplified diagram of the sizing system presented in Figure 2. The numbers in each box represent the numbers of U.S. Air Force men and women from the two major surveys whose hands fall in that particular size category. The number of individuals per size is determined by computer analysis (sizing program) of these surveys, and forms the basis of the estimated tariffs (see Procurement Tariff).

With very few exceptions, women have hand dimensions which fall in the four smaller sizes, while men predominate in the remaining larger ones. The only significant male-female overlap in key dimensions occurs in the Short Medium and Regular Medium size categories.

DEVELOPMENT OF DESIGN DATA

With the selection of the key dimensions and size categories, the next step was to establish values for the other dimensions to be incorporated into the design. This was done by treating all the individuals in the sizing base samples who fell within the limits of a given size category as a subsample, and computing the descriptive statistical values for each size from the key dimensional brackets defining this subgroup. Design values for the 22 hand dimensions were then developed from these descriptive statistics.

Since individuals within a single size category are generally not distributed normally--tending to cluster toward the mean of the total sample--statistical procedures for obtaining design values are modified accordingly (see Appendix A). For the current system, three basic length categories (Short, Regular, Long) and four circumference categories (Small, Medium, Large, X-Large) give the following midpoint values:

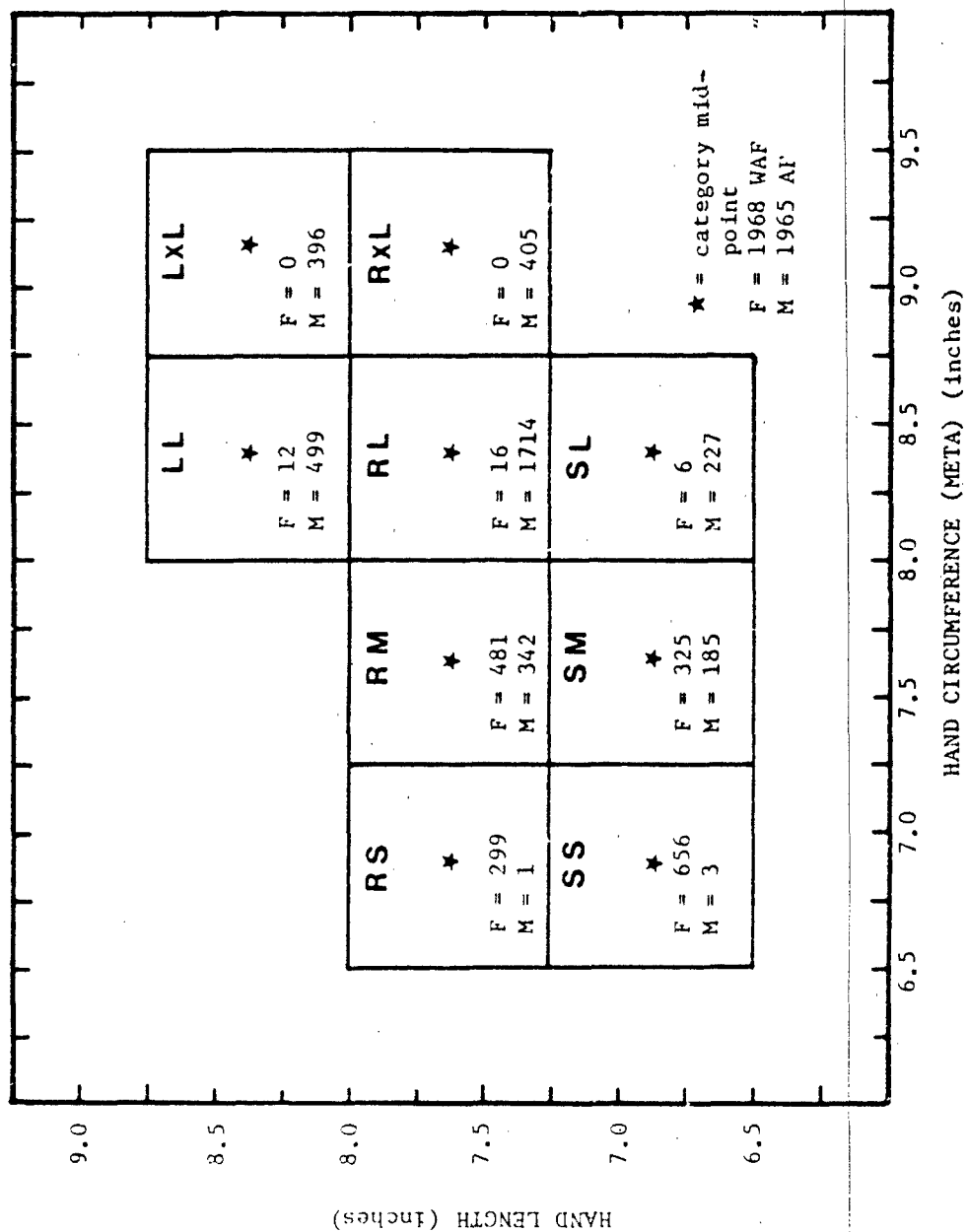


Figure 2. Relationship of the nine glove sizes to hand circumference at metacarpale and hand length for Air Force men and women.

<u>Size</u>	<u>Hand Length</u> (inches)	<u>Hand Circumference</u> (inches)
Short Small	6.88	6.88
Short Medium	6.88	7.63
Short Large	6.88	8.38
Regular Small	7.63	6.88
Regular Medium	7.63	7.63
Regular Large	7.63	8.38
Regular X-Large	7.63	9.13
Long Large	8.38	8.38
Long X-Large	8.38	9.13

To spread the distribution more evenly in each size category, so-called "MID-SIZE VALUES" are computed by the sizing program from multiple regression equations for each of the other variables using the above size category midpoints as predictors.

In order to assist in developing the final design values, the sizing program also computes additional statistical values. A modified standard deviation, called the within-a-size standard deviation (SZSD), is computed to be used with the MID-SIZE VALUE, much as a standard deviation is applied to a mean in normal distributions. A combination of the MID-SIZE VALUE plus or minus units of the SZSD, then, enables designers to estimate how small and how large to expect persons to be for a particular dimension within a particular size and establishes the adjustability which will be necessary to accommodate most persons whose measurements indicate that size. The values thus generated, termed the RANGE TO BE ACCOMMODATED, specify the range of variation for each hand dimension likely to have to be accommodated within a given size category. The methods of derivation of the various sizing values are described in Appendix A. Since the data for males and females were analyzed separately, copies of the sizing program printouts for only the pertinent size categories for each sample are provided in Appendix B.

In both sizing systems, the hand lengths of subjects who fall into the Short Medium (SM) size category, for example, range from 6.52 inches to 7.23 inches ($\text{MIDSIZE} + 1.65 \text{ SZ-SD}$). This is the RANGE TO BE ACCOMMODATED for that dimension in that size. The designer or patternmaker, of course, requires a single design value rather than a range of values for the actual fabrication of a garment. Design values are often chosen from the top of the range on the theory that smaller persons can, if necessary, wear larger garments, but larger persons cannot be accommodated by garments that are too small. In the case of chemical defense gloves, however, snugness is very important since a loose-fitting glove is likely to decrease job performance and its wearer risks getting caught in machinery. In addition, the stretchy materials used in these gloves should enable persons with hand sizes in the upper range of the size category to wear them. For these reasons all but one of the values selected as design values were MIDSIZE VALUES. The exception was wrist circumference. For this dimension snugness is not as critical as it is for the other dimensions; what is more important is that sufficient room is allowed for donning and doffing the gloves. In this case, the values at the upper end of the RANGE TO BE ACCOMMODATED (within each size) were used.

As indicated above, the sizing base data for females were used to establish design values for the smaller "female" sizes (RS and SS), while the male data were used for the larger longer "male" sizes. In order to facilitate selection of the design values for the integrated Small Medium and Regular Medium sizes, a table was developed which includes the original MIDSIZE VALUES generated by the sizing program for the males and females, the differences between these values (Δ), and the SZSDs. This information for 22 variables (including key dimensions) is given in Table 2. Examination of the table indicates that where males and females are in the same size category for a given dimension, the predicted values differ by less than 0.20 inch in a majority of cases. Similarly, the SZSDs give little indication of a difference in variability. Any integrated values selected from between these predicted MIDSIZE VALUES would fall well within the range of normal design tolerances. As a result of this analysis, male survey regression equations were used to arrive at design values for the two integrated sizes on the grounds that predicted male dimensions in these two size categories appeared to be nearly the same as those predicted from the female dimensions.

Table 3 gives the values for the design of hand forms for gloves to be worn over the bare hands. With the exceptions noted above, the values are the same as the MID-SIZE VALUES/size category presented in Appendix B.

The sizing values in Table 4 are for hand forms for gloves intended to be worn over glove liners. Since the gloves to be made from these forms are intended to be worn over a fabric glove liner, increments of thickness were added to the bare hand values to accommodate these liners. Two such liners were measured: the currently used Air Force gauntlet style and an experimental Army knit type. These measures established a thickness of approximately .04 inch (1 mm) for a single layer of material. The increments added took into account the amount of material which would affect the measure. For hand breadth .08 inch was added since material would fall between the glove and the bare hand on both sides of the hand. For the circumferences, an increment of .25 inch was added. This value was derived as follows:

$$\begin{aligned} \text{Bare Hand Circumference} &= 2\pi r \\ \text{Bare Hand + Liner Circ} &= 2\pi(r + .04) \\ \text{Bare Hand + Liner Circ} &= 2\pi r + 2\pi(.04) \\ \text{Bare Hand + Liner Circ} &= \text{Bare Hand Circ} + 2\pi(.04) \\ \text{Bare Hand + Liner Circ} &= \text{Bare Hand Circ} + .25 \end{aligned}$$

The bare hand circumference equation above is the equation for the circumference of a circle with radius r . Since the increase should be approximately uniform, this representation should be accurate. The increase in thickness is then represented by adding .04 to r .

For length measures, the increments added varied depending upon the start and end points for the measure. For crotch height .04 was added, since material underlies the dimension at only one point (the finger crotch or tip, but not the wrist). For the digit lengths, material underlies the dimensions at both ends; however, there is a counteractive effect, so dimensions are displaced but not changed. This displacement will be accounted for by the crotch heights.

TABLE 2

VARIATION IN MIDSIZE VALUES FOR MALES AND FEMALES
FOR SIZES TO BE INTEGRATED

Values in inches
(Male minus Female = Δ)

DIMENSIONS*	SHORT MEDIUM (SM)			REGULAR MEDIUM (RM)			SZSD M/F
	M	F	Δ	M	F	Δ	
1 Hand Circ Meta	7.63	7.63	.00	7.63	7.63	.00	.22/.22
2 Hand Breadth, Meta	3.18	3.12	.06	3.19	3.16	.03	.11/.11
3 Digit 1 Joint Circ	2.44	2.26	.18	2.52	2.29	.23	.13/.11
4 Dig 2 Dist Jnt Circ	1.90	1.80	.10	1.95	1.81	.14	.11/.09
5 Dig 3 Dist Jnt Circ	1.91	1.81	.10	1.96	1.81	.15	.11/.09
6 Dig 4 Dist Jnt Circ	1.84	1.71	.13	1.86	1.71	.15	.11/.08
7 Dig 5 Dist Jnt Circ	1.65	1.56	.09	1.68	1.56	.12	.12/.08
8 Dig 2 Pr Jnt Circ	2.30	2.17	.13	2.36	2.20	.16	.12/.10
9 Dig 3 Pr Jnt Circ	2.34	2.21	.13	2.43	2.24	.19	.13/.10
10 Dig 4 Pr Jnt Circ	2.17	2.05	.12	2.27	2.08	.19	.12/.09
11 Dig 5 Pr Jnt Circ	1.89	1.79	.10	1.97	1.83	.14	.12/.09
12 Wrist Circ	6.14	6.01	.13	6.29	6.13	.16	.28/.22
13 Crotch 1 Height	2.33	2.15	.18	2.58	2.46	.12	.20/.20
14 Crotch 2 Height	3.87	3.77	.10	4.28	4.18	.10	.17/.19
15 Crotch 3 Height	3.83	3.76	.07	4.21	4.15	.06	.17/.19
16 Crotch 4 Height	3.46	3.34	.12	3.74	3.72	.02	.16/.20
17 Digit 1 Tip-Crotch	2.09	2.05	.04	2.32	2.31	.01	.16/.15
18 Hand Length	6.88	6.88	.00	7.63	7.63	.00	.22/.22
19 Digit 2 Tip-Crotch**	2.65	2.67	-.02	2.85	2.94	-.09	.15/.17
20 Digit 3 Tip-Crotch**	2.96	3.01	-.05	3.29	3.31	-.02	.15/.16
21 Digit 4 Tip-Crotch**	2.80	2.81	-.01	3.08	3.11	-.03	.14/.17
22 Digit 5 Tip-Crotch**	2.11	2.12	-.01	2.32	2.32	.00	.16/.15

* See Figure 1 for full names of dimensions.

** Not adjusted for curvature as in Table 3 and Table 4.

TABLE 3

DESIGN VALUES FOR GLOVES TO BE WORN OVER BARE HANDS
(units are inches)

DIMENSIONS*	SHORT-SMALL	SHORT-MEDIUM**	SHORT-LARGE
1 Hand Circ, Meta	6.88	7.63	8.38
2 Hand Breadth, Meta	2.84	3.18	3.47
3 Digit 1 Joint Circ	2.09	2.44	2.57
4 Digit 2 Dst Jnt Circ	1.67	1.90	2.02
5 Digit 3 Dst Jnt Circ	1.67	1.91	2.04
6 Digit 4 Dst Jnt Circ	1.58	1.84	1.96
7 Digit 5 Dst Jnt Circ	1.44	1.65	1.77
8 Digit 2 Pr Jnt Circ	2.02	2.30	2.43
9 Digit 3 Pr Jnt Circ	2.07	2.34	2.47
10 Digit 4 Pr Jnt Circ	1.93	2.17	2.29
11 Digit 5 Pr Jnt Circ	1.68	1.89	2.01
12 Wrist Circ ***	5.97	6.61	7.10
13 Crotch 1 Height	2.22	2.33	2.38
14 Crotch 2 Height	3.79	3.87	3.87
15 Crotch 3 Height	3.77	3.83	3.83
16 Crotch 4 Height	3.33	3.46	3.49
17 Digit 1 Tip-Crotch	2.05	2.09	2.04
18 Hand Length †	6.88	6.88	6.88
19 Digit 2 Tip-Crotch ††	2.50	2.56	2.61
20 Digit 3 Tip-Crotch ††	2.97	2.98	2.99
21 Digit 4 Tip-Crotch ††	3.01	2.99	3.02
22 Digit 5 Tip-Crotch ††	1.84	1.92	1.96
23 Base Circumference	13.00	13.00	13.00
24 Total Length	17.50	17.50	17.50

* See Figure 1 for full names of dimensions.

** Integrated size (male data base).

*** Within-size 95th percentile used (MID-SIZE + 1.65 SZSD).

† Because the hand forms are designed with fingers somewhat curved, hand length remains as a key dimension for purposes of establishing size categories and calculating other design dimensions, but is not itself a design dimension in this sizing program.

†† Adjusted from data base MIDSIZE VALUES to allow for curvature (see Appendix A).

TABLE 3 (cont'd)

DIMENSIONS*	REG.-SMALL	REG.-MEDIUM**	REG.-LARGE
1 Hand Circ, Meta	6.88	7.63	8.38
2 Hand Breadth, Meta	2.87	3.19	3.48
3 Digit 1 Joint Circ	2.13	2.52	2.64
4 Digit 2 Dst Jnt Circ	1.68	1.95	2.07
5 Digit 3 Dst Jnt Circ	1.68	1.96	2.10
6 Digit 4 Dst Jnt Circ	1.58	1.86	1.98
7 Digit 5 Dst Jnt Circ	1.44	1.68	1.80
8 Digit 2 Pr Jnt Circ	2.06	2.36	2.50
9 Digit 3 Pr Jnt Circ	2.10	2.43	2.56
10 Digit 4 Pr Jnt Circ	1.96	2.27	2.38
11 Digit 5 Pr Jnt Circ	1.72	1.97	2.09
12 Wrist Circ ***	6.08	6.76	7.25
13 Crotch 1 Height	2.53	2.58	2.63
14 Crotch 2 Height	4.20	4.28	4.28
15 Crotch 3 Height	4.17	4.21	4.21
16 Crotch 4 Height	3.72	3.74	3.77
17 Digit 1 Tip-Crotch	2.32	2.32	2.27
18 Hand Length †	7.63	7.63	7.63
19 Digit 2 Tip-Crotch ††	2.74	2.73	2.80
20 Digit 3 Tip-Crotch ††	3.31	3.33	3.35
21 Digit 4 Tip-Crotch ††	3.36	3.32	3.33
22 Digit 5 Tip-Crotch ††	2.01	2.08	2.15
23 Base Circumference	13.00	13.00	13.00
24 Total Length	17.50	17.50	17.50

* See Figure 1 for full names of dimensions.

** Integrated size (male data base).

*** Within-size 95th percentile used (MID-SIZE + 1.65 SZSD).

† Because the hand forms are designed with fingers somewhat curved, hand length remains as a key dimension for purposes of establishing size categories and calculating other design dimensions, but is not itself a design dimension in this sizing program.

†† Adjusted from data base MIDSIZE VALUES to allow for curvature (see Appendix A).

TABLE 3 (cont'd)

DIMENSIONS*	REG.-XLARGE	LONG-LARGE	LONG-XLARGE
1 Hand Circ, Meta	9.13	8.38	9.13
2 Hand Breadth, Meta	3.77	3.49	3.78
3 Digit 1 Jnt Circ	2.76	2.71	2.84
4 Digit 2 Dst Jnt Circ	2.20	2.13	2.25
5 Digit 3 Dst Jnt Circ	2.23	2.15	2.29
6 Digit 4 Dst Jnt Circ	2.09	2.00	2.12
7 Digit 5 Dst Jnt Circ	1.93	1.83	1.95
8 Digit 2 Pr Jnt Circ	2.63	2.56	2.70
9 Digit 3 Pr Jnt Circ	2.69	2.65	2.78
10 Digit 4 Pr Jnt Circ	2.50	2.48	2.59
11 Digit 5 Pr Jnt Circ	2.22	2.17	2.30
12 Wrist Circ ***	7.74	7.40	7.89
13 Crotch 1 Height	2.68	2.88	2.93
14 Crotch 2 Height	4.27	4.68	4.68
15 Crotch 3 Height	4.21	4.59	4.59
16 Crotch 4 Haight	3.80	4.05	4.08
17 Digit 1 Tip-Crotch	2.23	2.51	2.46
18 Hand Length †	7.63	8.38	8.38
19 Digit 2 Length ††	2.88	2.98	3.05
20 Digit 3 Length ††	3.36	3.69	3.71
21 Digit 4 Length ††	3.35	3.67	3.69
22 Digit 5 Length ††	2.22	2.32	2.38
23 Base Circumference	13.00	13.00	13.00
24 Total Length	17.50	17.50	17.50

* See Figure 1 for full names of dimensions.

*** Within-size 95th percentile used (MID-SIZE + 1.65 SZSD).

† Because the hand forms are designed with fingers somewhat curved, hand length remains as a key dimension for purposes of establishing size categories and calculating other design dimensions, but is not itself a design dimension in this sizing program.

†† Adjusted from data base MIDSIZE VALUES to allow for curvature (see Appendix A).

TABLE 4
SIZING VALUES FOR GLOVES TO BE WORN OVER LINERS
(units are inches)

DIMENSIONS*	SHORT-SMALL	SHORT-MEDIUM**	SHORT-LARGE
1 Hand Circ, Meta	7.13	7.88	8.63
2 Hand Breadth, Meta	2.92	3.26	3.55
3 Digit 1 Joint Circ	2.34	2.69	2.82
4 Digit 2 Dst Jnt Circ	1.92	2.15	2.27
5 Digit 3 Dst Jnt Circ	1.92	2.16	2.29
6 Digit 4 Dst Jnt Circ	1.83	2.09	2.21
7 Digit 5 Dst Jnt Circ	1.69	1.90	2.02
8 Digit 2 Pr Jnt Circ	2.27	2.55	2.68
9 Digit 3 Pr Jnt Circ	2.32	2.59	2.72
10 Digit 4 Pr Jnt Circ	2.18	2.42	2.54
11 Digit 5 Pr Jnt Circ	1.93	2.14	2.26
12 Wrist Circ ***	6.37	6.86	7.35
13 Crotch 1 Height	2.26	2.37	2.42
14 Crotch 2 Height	3.83	3.91	4.24
15 Crotch 3 Height	3.81	3.87	3.87
16 Crotch 4 Height	3.37	3.50	3.53
17 Digit 1 Tip-Crotch	2.05	2.09	2.04
18 Hand Length †	6.92	6.92	6.92
19 Digit 2 Tip-Crotch ††	2.50	2.56	2.61
20 Digit 3 Tip-Crotch ††	2.97	2.98	2.99
21 Digit 4 Tip-Crotch ††	3.01	2.99	3.02
22 Digit 5 Tip-Crotch ††	1.84	1.92	1.96
23 Base Circumference	13.00	13.00	13.00
24 Total Length	17.50	17.50	17.50

* See Figure 1 for full names of dimensions.

** Integrated size (male data base).

** Within-size 95th percentile used (MID-SIZE + 1.65 SZSD).

† Because the hand forms are designed with fingers somewhat curved, hand length remains as a key dimension for purposes of establishing size categories and calculating other design dimensions, but is not itself a design dimension in this sizing program.

†† Adjusted from data base MIDSIZED values to allow for curvature (see Appendix A).

TABLE 4 (cont'd)

DIMENSIONS*	REG.-SMALL	REG.-MEDIUM**	REG.-LARGE
1 Hand Circ, Meta	7.13	7.88	8.63
2 Hand Breadth, Meta	2.95	3.27	3.56
3 Digit 1 Joint Circ	2.38	2.77	2.89
4 Digit 2 Dst Jnt Circ	1.93	2.20	2.32
5 Digit 3 Dst Jnt Circ	1.93	2.21	2.35
6 Digit 4 Dst Jnt Circ	1.83	2.11	2.23
7 Digit 5 Dst Jnt Circ	1.69	1.93	2.05
8 Digit 2 Pr Jnt Circ	2.31	2.61	2.75
9 Digit 3 Pr Jnt Circ	2.35	2.68	2.81
10 Digit 4 Pr Jnt Circ	2.21	2.52	2.63
11 Digit 5 Pr Jnt Circ	1.97	2.22	2.34
12 Wrist Circ ***	6.52	6.51	7.50
13 Crotch 1 Height	2.57	2.62	2.67
14 Crotch 2 Height	4.24	4.32	4.32
15 Crotch 3 Height	4.21	4.25	4.25
16 Crotch 4 Height	3.76	3.78	3.81
17 Digit 1 Tip-Crotch	2.32	2.32	2.27
18 Hand Length †	7.67	7.67	7.67
19 Digit 2 Tip-Crotch ††	2.74	2.73	2.80
20 Digit 3 Tip-Crotch ††	3.31	3.33	3.35
21 Digit 4 Tip-Crotch ††	3.36	3.32	3.33
22 Digit 5 Tip-Crotch ††	2.01	2.08	2.15
23 Base Circumference	13.00	13.00	13.00
24 Total Length	17.50	17.50	17.50

* See Figure 1 for full names of dimensions.

** Integrated size (male data base).

*** Within-size 95th percentile used (MID-SIZE + 1.65 SZSD).

† Because the hand forms are designed with fingers somewhat curved, hand length remains as a key dimension for purposes of establishing size categories and calculating other design dimensions, but is not itself a design dimension in this sizing program.

†† Adjusted from data base MIDSIZED values to allow for curvature (see Appendix A).

TABLE 4 (cont'd)

DIMENSIONS*	REG.-XLARGE	LONG-LARGE	LONG-XLARGE
1 Hand Circ, Meta	9.38	8.63	9.38
2 Hand Breadth, Meta	3.85	3.57	3.86
3 Digit 1 Joint Circ	3.01	2.96	3.09
4 Digit 2 Dst Jnt Circ	2.45	2.38	2.50
5 Digit 3 Dst Jnt Circ	2.48	2.40	2.54
6 Digit 4 Dst Jnt Circ	2.34	2.25	2.37
7 Digit 5 Dst Jnt Circ	2.18	2.08	2.20
8 Digit 2 Pr Jnt Circ	2.88	2.81	2.95
9 Digit 3 Pr Jnt Circ	2.94	2.90	3.03
10 Digit 4 Pr Jnt Circ	2.75	2.73	2.84
11 Digit 5 Pr Jnt Circ	2.47	2.42	2.55
12 Wrist Circ ***	7.99	7.65	8.14
13 Crotch 1 Height	2.72	2.92	2.97
14 Crotch 2 Height	4.31	4.72	4.72
15 Crotch 3 Height	4.25	4.63	4.63
16 Crotch 4 Height	3.84	4.09	4.12
17 Digit 1 Tip-Crotch	2.23	2.51	2.46
18 Hand Length †	7.67	8.42	8.42
19 Digit 2 Tip-Crotch ††	2.88	2.98	3.05
20 Digit 3 Tip-Crotch ††	3.36	3.69	3.71
21 Digit 4 Tip-Crotch ††	3.35	3.67	3.69
22 Digit 5 Tip-Crotch ††	2.22	2.32	2.38
23 Base Circumference	13.00	13.00	13.00
24 Total Length	17.50	17.50	17.50

* See Figure 1 for full names of dimensions.

*** Within-size 95th percentile used (MID-SIZE + 1.65 SZSD).

† Because the hand forms are designed with fingers somewhat curved, hand length remains as a key dimension for purposes of establishing size categories and calculating other design dimensions, but is not itself a design dimension in this sizing program.

†† Adjusted from data base MIDSIZED values to allow for curvature (see Appendix A).

Procurement Tariff

Using the per size category numbers of females and males as computed from the 1968 Air Force women and 1965 Air Force men survey samples (see Figure 2), estimates of the number of persons in the total Air Force population who would wear each size is presented in Table 5. These estimates are weighted based upon an Air Force comprised of 15% females and 85% males.

TABLE 5
ESTIMATED TARIFF FOR THE NINE-SIZE SYSTEM

<u>Size</u>	<u>Pairs of Gloves per 1000 Air Force Population</u>
SHORT	
1. Small	56
2. Medium	69
3. Large	52
MEDIUM	
4. Small	25
5. Medium	117
6. Large	388
7. X-Large	91
LONG	
8. Large	113
9. X-Large	89
TOTAL	1000

APPENDIX A

METHODS AND PROCEDURES FOR COMPUTATION AND USE OF SIZING VALUES

The design values for 22 of the 24 variables listed in the text (Table 3 and Table 4) derive from the statistics compiled from the Garrett male and female samples via a computerized sizing program. Copies of the printouts which provide sizing data for all 22 hand dimensions are presented in the tables in Appendix B. Printouts are included only as they apply to the source of the final design values—that is, female sample data for sizes SHORT-SMALL and REGULAR SMALL; male sample data for all others including the "integrated" sizes SHORT MEDIUM and REGULAR MEDIUM for which the male values were adopted. A number of the statistical parameters which appear on the tables were briefly discussed in the text; however, in order to enable efficient use of the information, some additional description is needed. It is assumed that the reader is familiar with many of the basic statistics which are not exclusive to sizing applications -- mean, standard deviation, standard error, and correlation coefficient, for example. The paragraphs below describe briefly how these statistics are applied to the sizing data presented.

The complete sample statistical information for each of the hand dimensions selected from Garrett's data is presented in Table A-1 and Table A-2 for the female and male samples, respectively. Following the name of each dimension, the tables give the arithmetic mean value (MEAN), standard deviation (SDV), standard error of the estimate (SE-EST), and a special standard error related to sizing usage (SZ-SE, calculated from the SE-EST). Next, the tables give the correlation coefficient values (R) relating hand circumference at metacarpale [R(X)] and hand length [R(Y)] to each variable, the multiple correlation (MULT-R) which considers the relationship of X and Y combined to each variable, and the regression equations (THE EQUATIONS). The R values are the product moment correlation coefficients (usually identified as r), the mathematical derivation of which may be found in most statistics textbooks. The R values quantitate the degree of interrelationship between the key dimensions (X and Y) and each of the other hand dimensions individually such that a perfect correlation equals 1.000 and no correlation equals 0.000. The values may be positive (for example, $R = +1.000$ means that the variables increase or decrease exactly together), or negative (for example, $R = -0.600$ implies that one variable increases as the other decreases). The MULT-R considers the combined X and Y relationship with the dimension and is calculated directly from the simple R values without additional recourse to the original data.

Along with the means and standard deviations, the correlation coefficients provide the necessary information for computing the multiple regressions which are of the linear, least squares type. The equations take the form $Z = AX + BY + C$ where:

- Z = predicted value for a specific dimension
- X = hand circumference, meta (key dimension)
- Y = hand length (key dimension)

A = weighting coefficient (slope) for X
B = weighting coefficient (slope) for Y
C = constant (intercept)

The equations, which are calculated on the basis of the total sample n, permit prediction of an average value for each dimension at selected values of X and Y. The SZ-SE value is the error term for each equation and identifies the amount of variation in size to be expected about the predicted value. For example, if one wished to predict hand breadth (variable #2) when hand circumference (X) = 6.88 inches and hand length (Y) = 6.88 inches (MIDSIZE VALUES), the regression for females would be:

Hand Breadth, Metacarpale = $.380X + .042Y - .064$
Hand Breadth, Metacarpale = $.380 \times 6.88 + .042 \times 6.88 - .064$
Hand Breadth, Metacarpale = 2.84 inches (See SHORT SMALL MIDSIZE VALUE
for females, Table B-1)

The SZ-SE for the regression equals .105; therefore, the actual hand breadth would likely fall between 2.74 and 2.95 inches two-thirds of the time.

Using the information contained in Tables A-1 and A-2, the program computes the sizing data for each size category using a standard format. Tables B-1 and B-2 present the sizing data for the two size categories (SHORT SMALL and REGULAR SMALL) which used the basic female data for input in the selection of the final design values. Tables B-3 through B-9 provide the comparable per-size category data from the male sample which was used for the other sizes. Each table lists the range (interval) for the key dimensions as they relate to the size category specified, the number of individuals from the total sample (n) assigned to the category, and the percentage of the total sample that this number represents (TARIFF PERCENTAGE). Below, the sizing data for each dimension (named and numbered) are listed for the category.

The statistical method most commonly used to describe the range of values in a given group of normally distributed data involves the derivation of the mean (X) value to which multiples of the standard deviation (SD) are added or subtracted. The normal distribution curve in Figure A-1 illustrates the magnitude of the range covered by various multiples (plus or minus) of the SD. For sizing purposes, however, this approach must be somewhat modified since dimensional data divided into size categories are not necessarily normally distributed. Typically, the data are weighted toward the center of distribution of the total sample. To overcome this problem, the sizing program uses the midpoint of the key dimensional intervals for each size to calculate a MID-SIZE VALUE estimate of central tendency from the appropriate regression equation for each variable.

The category midpoint values of the key dimensions are listed in the text on page 15. These values were used in the regression equations (Tables A-1 and A-2) to produce the MIDSIZE VALUES listed in Tables B-1 through B-9.

TABLE A-1

SUMMARY STATISTICS AND REGRESSION EQUATIONS FOR THE
TWENTY-TWO HAND DIMENSIONS - FEMALES

	MEAN	SD	SE-ES	SZ-SE	R(X)	R(Y)	MULT-R	---THE EQUATIONS---		
1 HAND CIRC, METACARP	7.37	.33	.00	.217	1.000	.564	1.000	$1.000^*X + .000^*Y +$	.000	.000
2 HAND BREADTH, META	3.03	.15	.07	.105	.894	.569	.898	$.380^*X + .042^*Y +$	-.064	
3 DIGIT 1 JOINT CIRC	2.21	.13	.10	.114	.614	.430	.622	$.219^*X + .048^*Y +$	.257	
4 DIG 2 OST JNT CIRC	1.76	.10	.08	.092	.577	.349	.578	$.176^*X + .011^*Y +$	.388	
5 DIG 3 OST JNT CIRC	1.76	.10	.08	.090	.593	.351	.593	$.180^*X + .007^*Y +$	.386	
6 DIG 4 OST JNT CIRC	1.66	.09	.08	.084	.603	.358	.604	$.171^*X + .007^*Y +$	.351	
7 DIG 5 OST JNT CIRC	1.52	.09	.08	.084	.571	.330	.571	$.162^*X + .003^*Y +$	.304	
8 DIG 2 PR JNT CIRC	2.12	.11	.09	.097	.628	.445	.638	$.191^*X + .044^*Y +$	.405	
9 DIG 3 PR JNT CIRC	2.17	.11	.09	.097	.615	.431	.624	$.187^*X + .041^*Y +$	.503	
10 DIG 4 PR JNT CIRC	2.01	.10	.09	.093	.553	.394	.562	$.155^*X + .037^*Y +$	.607	
11 DIG 5 PR JNT CIRC	1.76	.10	.08	.087	.575	.448	.595	$.145^*X + .053^*Y +$	.320	
12 WRIST CIRC	5.90	.28	.18	.221	.740	.543	.756	$.546^*X + .153^*Y +$	.799	
13 CROTCH 1 HEIGHT	2.25	.22	.18	.201	.227	.569	.580	$-.092^*X + .419^*Y +$	-.025	
14 CROTCH 2 HEIGHT	3.88	.24	.16	.195	.398	.754	.754	$-.028^*X + .542^*Y +$	.263	
15 CROTCH 3 HEIGHT	3.86	.23	.15	.192	.401	.748	.748	$-.022^*X + .527^*Y +$	.296	
16 CROTCH 4 HEIGHT	3.43	.24	.16	.196	.419	.734	.734	$.006^*X + .512^*Y +$	-.226	
17 DIGIT 1 TIP-CROTCH	2.11	.17	.13	.148	.384	.687	.687	$-.002^*X + .355^*Y +$	-.375	
18 HAND LENGTH	7.06	.34	.00	.217	.564	1.000	1.000	$.000^*X + 1.000^*Y +$	.000	
19 DIGIT 2 TIP-CROTCH	2.72	.20	.15	.169	.475	.672	.682	$.000^*X + .358^*Y +$	-.460	
20 DIGIT 3 TIP-CROTCH	3.07	.20	.13	.159	.483	.749	.753	$.055^*X + .411^*Y +$	-.240	
21 DIGIT 4 TIP-CROTCH	2.88	.20	.14	.170	.414	.699	.700	$.019^*X + .409^*Y +$	-.148	
22 DIGIT 5 TIP-CROTCH	2.15	.17	.14	.149	.438	.613	.623	$.072^*X + .275^*Y +$	-.321	

TABLE A-2

SUMMARY STATISTICS AND REGRESSION EQUATIONS FOR THE
TWENTY-TWO HAND DIMENSIONS - MALES

	MEAN	SDV	SE-ES	SZ-SE	R(X)	R(Y)	MULT-R	---THE EQUATIONS---		
1 HAND CIRC, METACARP	8.50	.35	.00	.217	1.000	.586	1.000	1.000*X+	.000*Y+	.000
2 HAND BREADTH, META	3.53	.16	.07	.112	.885	.545	.825	.387*X+	.017*Y+	.104
3 DIGIT 1 JOINT CIRC	2.67	.15	.12	.130	.532	.469	.566	.165*X+	.097*Y+	.516
4 DIG 2 DST JNT CIRC	2.10	.13	.11	.114	.552	.450	.573	.163*X+	.069*Y+	.185
5 DIG 3 DST JNT CIRC	2.13	.13	.11	.113	.596	.478	.617	.182*X+	.071*Y+	.030
6 DIG 4 DST JNT CIRC	2.00	.12	.10	.110	.505	.351	.510	.157*X+	.028*Y+	.449
7 DIG 5 DST JNT CIRC	1.83	.13	.11	.115	.523	.373	.529	.160*X+	.035*Y+	.124
8 DIG 2 PR JNT CIRC	2.53	.14	.11	.119	.584	.490	.612	.179*X+	.086*Y+	.342
9 DIG 3 PR JNT CIRC	2.60	.15	.12	.128	.579	.528	.624	.176*X+	.119*Y+	.175
10 DIG 4 PR JNT CIRC	2.42	.15	.12	.124	.554	.532	.610	.153*X+	.126*Y+	.137
11 DIG 5 PR JNT CIRC	2.13	.14	.11	.121	.574	.515	.615	.160*X+	.105*Y+	-.117
12 WRIST CIRC	6.89	.37	.24	.284	.741	.566	.759	.654*X+	.202*Y+	-.241
13 CROTCH 1 HEIGHT	2.68	.23	.19	.203	.405	.583	.588	.064*X+	.335*Y+	-.462
14 CROTCH 2 HEIGHT	4.35	.24	.13	.174	.488	.843	.843	-.007*X+	.546*Y+	.168
15 CROTCH 3 HEIGHT	4.28	.23	.13	.171	.474	.818	.818	-.005*X+	.510*Y+	.367
16 CROTCH 4 HEIGHT	3.83	.20	.14	.161	.472	.723	.725	.041*X+	.374*Y+	.572
17 DIGIT 1 TIP-CROTCH	2.31	.18	.14	.159	.248	.572	.582	-.066*X+	.311*Y+	.453
18 HAND LENGTH	7.76	.37	.00	.217	.586	1.000	1.000	.000*X+	1.000*Y+	.000
19 DIGIT 2 TIP-CROTCH	2.96	.18	.13	.148	.496	.655	.669	.087*X+	.273*Y+	.111
20 DIGIT 3 TIP-CROTCH	3.37	.20	.11	.149	.512	.826	.826	.024*X+	.441*Y+	-.257
21 DIGIT 4 TIP-CROTCH	3.17	.19	.11	.139	.516	.801	.803	.037*X+	.384*Y+	-.131
22 DIGIT 5 TIP-CROTCH	2.42	.19	.15	.160	.457	.625	.635	.074*X+	.282*Y+	-.399

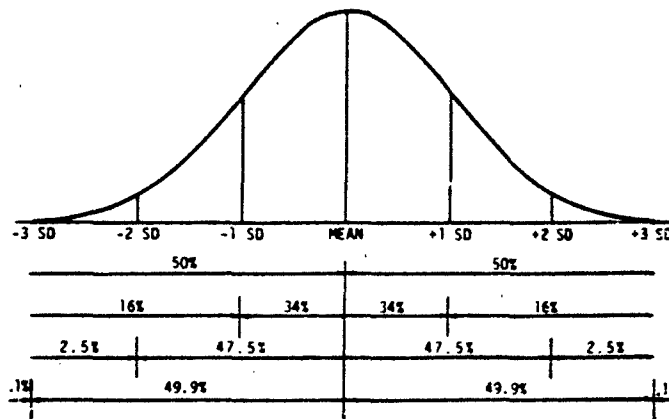


Figure A-1. Normal distribution indicating approximate population percentiles with specified standard deviations (SD).

To create the size standard deviation (SZSD) which accompanies the MID-SIZE VALUE on the sizing tables, the SE EST was employed. The formula for computing the SZSD is as follows:

$$SZSD_z = \sqrt{\frac{SE\ EST^2 + (A * INTERVAL\ WIDTH_x)^2}{12} + \frac{(B * INTERVAL\ WIDTH_y)^2}{12}}$$

where A and B are the same as in each regression equation (see page 25), interval widths x and y are the size category interval widths for the key dimensions, and 1/12 is Sheppard's correction for grouping.

Using the earlier example of hand breadth, the values in the equation are as follows:

$$\text{Hand Breadth SZSD} = \sqrt{(.07)^2 + \frac{(.380 \times .75)^2}{12} + \frac{(.042 \times .75)^2}{12}} = .108$$

This value rounds to .11 and may be found on Table B-1. Since each size category within the sizing system was selected so that the interval widths of the key dimensions are the same, the SZSD will be the same for all sizes for a given dimension.

Once the MID-SIZE VALUE and the SZSD were computed for each dimension, these statistics were employed to create the RANGE TO BE ACCOMMODATED values.

These values represent approximately the 5th to 95th percentile values within a size and are the MID-SIZE values plus or minus 1.65 SZSD. The SZSD functions in the same way as the total sample standard deviation as shown in Figure A-1.

If the designer desires values at some other point, the regression equations provided can be used. For example, the designer may desire values at the small end of a size category for a group of dimensions. The smaller key dimension values can simply be inserted into the appropriate equations. Indeed, supplied with the procedures described in this report and the regression equations, the designer can create a complete set of values for one or more additional sizes and even create entire new size programs.

Four of the measures taken in Garrett (1970a and 1970b) were not used in their original form. The finger lengths (tip-crotch measures) Garrett measured with the fingers straight and from a point at the center of each finger on the palmar surface. Since curved finger lengths were desired for this purpose, the measurement was transferred to a specified finger crotch so that the length would be constant no matter what curvature was used. However, this required a slight adjustment in the values to account for a change in the proximal locations of the measure. These adjustments are reflected in the sizing criteria presented in the main body of the text (Table 3 and Table 4). The adjusted equations are as follows:

- DIGIT 2 LENGTH: one half the absolute value of the adjustment to Digit 4 was subtracted from Digit 2 Tip-Crotch
- DIGIT 3 LENGTH: Crotch 3 Height was subtracted from Crotch 2 Height, divided by 2, then added to Digit 3 Tip-Crotch
- DIGIT 4 LENGTH: Crotch 4 Height was subtracted from Crotch 3 Height, divided by 2, then added to Digit 4 Tip-Crotch
- DIGIT 5 LENGTH: the absolute value of the Digit 4 adjustment was subtracted from Digit 5 Tip-Crotch

APPENDIX B

SIZING DATA FOR THE NINE SIZE CATEGORIES

TABLE B-1

SHORT SMALL

THE RANGE FOR HAND CIRC. METACARP 6.50 - 7.25

THE RANGE FOR HAND LENGTH 6.50 - 7.25

N = 69 TARIFF PERCENTAGE = 34.67%

	VAR NO	MID-SIZE VALUE	SZ-SO	RANGE TO BE ACCOMMODATED
HAND CIRC. METACARP	1	6.68	.22	6.52 - 7.23
HAND BREADTH, META	2	2.84	.11	2.67 - 3.01
DIGIT 1 JOINT CIRC	3	2.09	.11	1.91 - 2.20
DIG 2 DST JNT CIRC	4	1.67	.09	1.52 - 1.82
DIG 3 DST JNT CIRC	5	1.67	.09	1.52 - 1.82
DIG 4 DST JNT CIRC	6	1.50	.08	1.44 - 1.72
DIG 5 DST JNT CIRC	7	1.44	.08	1.30 - 1.50
DIG 2 PR JNT CIRC	8	2.02	.10	1.86 - 2.10
DIG 3 PR JNT CIRC	9	2.07	.10	1.91 - 2.23
DIG 4 PR JNT CIRC	10	1.93	.09	1.70 - 2.00
DIG 5 PR JNT CIRC	11	1.60	.09	1.54 - 1.83
WRIST CIRC	12	5.60	.22	5.24 - 5.97
CROTCH 1 HEIGHT	13	2.22	.20	1.89 - 2.55
CROTCH 2 HEIGHT	14	3.79	.19	3.47 - 4.12
CROTCH 3 HEIGHT	15	3.77	.19	3.46 - 4.09
CROTCH 4 HEIGHT	16	3.33	.20	3.01 - 3.66
DIGIT 1 TIP-CROTCH	17	2.05	.15	1.81 - 2.29
HAND LENGTH	18	6.80	.22	6.52 - 7.23
DIGIT 2 TIP-CROTCH	19	2.61	.17	2.33 - 2.89
DIGIT 3 TIP-CROTCH	20	2.96	.16	2.70 - 3.23
DIGIT 4 TIP-CROTCH	21	2.79	.17	2.51 - 3.07
DIGIT 5 TIP-CROTCH	22	2.06	.15	1.82 - 2.31

UNITS ARE INCHES

TABLE B-2

REGULAR SHALL

THE RANGE FOR HAND CIRC. METACARP 6.50 - 7.25
 THE RANGE FOR HAND LENGTH 7.25 - 8.00

N = 5 TARIFF PERCENTAGE = 2.51%

	VAR NO	HID-SIZE VALUE	SZ-50	RANGE TO BE ACCOMMODATED
HAND CIRC. METACARP	1	6.88	.22	6.52 - 7.23
HAND BREADTH, META	2	2.87	.11	2.70 - 3.04
DIGIT 1 JOINT CIRC	3	2.13	.11	1.94 - 2.32
DIG 2 DST JNT CIRC	4	1.68	.09	1.52 - 1.83
DIG 3 DST JNT CIRC	5	1.68	.09	1.53 - 1.83
DIG 4 DST JNT CIRC	6	1.58	.08	1.44 - 1.72
DIG 5 DST JNT CIRC	7	1.44	.08	1.30 - 1.58
DIG 2 PR JNT CIRC	8	2.06	.10	1.90 - 2.21
DIG 3 PR JNT CIRC	9	2.10	.10	1.94 - 2.26
DIG 4 PR JNT CIRC	10	1.96	.09	1.81 - 2.11
DIG 5 PR JNT CIRC	11	1.72	.09	1.58 - 1.87
WRIST CIRC	12	5.72	.22	5.35 - 6.00
CROTCH 1 HEIGHT	13	2.53	.20	2.20 - 2.86
CROTCH 2 HEIGHT	14	4.20	.19	3.88 - 4.52
CROTCH 3 HEIGHT	15	4.17	.19	3.95 - 4.49
CROTCH 4 HEIGHT	16	3.72	.20	3.40 - 4.04
DIGIT 1 TIP-CROTCH	17	2.32	.15	2.07 - 2.56
HAND LENGTH	18	7.62	.22	7.27 - 7.98
DIGIT 2 TIP-CROTCH	19	2.87	.17	2.60 - 3.15
DIGIT 3 TIP-CROTCH	20	3.27	.16	3.01 - 3.54
DIGIT 4 TIP-CROTCH	21	3.10	.17	2.82 - 3.38
DIGIT 5 TIP-CROTCH	22	2.27	.15	2.03 - 2.52

UNITS ARE INCHES

TABLE B-3

SHORT MEDIUM

THE RANGE FOR HAND CIRC. METACARP 7.25 - 8.00
 THE RANGE FOR HAND LENGTH 6.50 - 7.25

N = 4 TARIFF PERCENTAGE = 2.74%

	VAR NO	MID-SIZE VALUE	SZ-SO	RANGE TO BE ACCOMMODATED
HAND CIRC. METACARP	1	7.63	.22	7.27 - 7.90
HAND BREADTH, META	2	3.18	.11	2.99 - 3.36
DIGIT 1 JOINT CIRC	3	2.44	.13	2.23 - 2.66
DIG 2 DST JNT CIRC	4	1.90	.11	1.71 - 2.09
DIG 3 DST JNT CIRC	5	1.91	.11	1.72 - 2.09
DIG 4 DST JNT CIRC	6	1.84	.11	1.66 - 2.02
DIG 5 DST JNT CIRC	7	1.65	.12	1.46 - 1.84
DIG 2 PR JNT CIRC	8	2.30	.12	2.10 - 2.50
DIG 3 PR JNT CIRC	9	2.34	.13	2.13 - 2.55
DIG 4 PR JNT CIRC	10	2.17	.12	1.97 - 2.38
DIG 5 PR JNT CIRC	11	1.89	.12	1.69 - 2.09
WRIST CIRC	12	6.14	.20	5.67 - 6.61
CROTCH 1 HEIGHT	13	2.33	.20	1.99 - 2.66
CROTCH 2 HEIGHT	14	3.87	.17	3.50 - 4.16
CROTCH 3 HEIGHT	15	3.83	.17	3.55 - 4.11
CROTCH 4 HEIGHT	16	3.46	.16	3.19 - 3.73
DIGIT 1 TIP-CROTCH	17	2.09	.16	1.83 - 2.35
HAND LENGTH	18	6.88	.22	6.52 - 7.23
DIGIT 2 TIP-CROTCH	19	2.65	.15	2.40 - 2.89
DIGIT 3 TIP-CROTCH	20	2.96	.15	2.71 - 3.21
DIGIT 4 TIP-CROTCH	21	2.80	.14	2.57 - 3.03
DIGIT 5 TIP-CROTCH	22	2.11	.16	1.84 - 2.37

UNITS ARE INCHES

TABLE B-4

SHORT LARGE

THE RANGE FOR HAND CIRC. NETACARP 8.00 - 8.75
 THE RANGE FOR HAND LENGTH 6.50 - 7.25

N = 7 TARIFF PERCENTAGE = 4.79%

	VAR NO	HID-SIZE VALUE	SZ-50	RANGE TO BE ACCOMMODATED
HAND CIRC. NETACARP	1	8.38	.22	8.02 - 8.73
HAND BREADTH, META	2	3.47	.11	3.28 - 3.65
DIGIT 1 JOINT CIRC	3	2.57	.13	2.35 - 2.78
DIG 2 DST JNT CIRC	4	2.02	.11	1.83 - 2.21
DIG 3 DST JNT CIRC	5	2.04	.11	1.86 - 2.23
DIG 4 DST JNT CIRC	6	1.96	.11	1.77 - 2.14
DIG 5 DST JNT CIRC	7	1.77	.12	1.58 - 1.96
DIG 2 PR JNT CIRC	8	2.43	.12	2.24 - 2.63
DIG 3 PR JNT CIRC	9	2.47	.13	2.26 - 2.68
DIG 4 PR JNT CIRC	10	2.29	.12	2.08 - 2.49
DIG 5 PR JNT CIRC	11	2.01	.12	1.81 - 2.21
WRIST CIRC	12	6.63	.28	6.16 - 7.10
CROTCH 1 HEIGHT	13	2.38	.20	2.04 - 2.71
CROTCH 2 HEIGHT	14	3.87	.17	3.58 - 4.15
CROTCH 3 HEIGHT	15	3.83	.17	3.55 - 4.11
CROTCH 4 HEIGHT	16	3.49	.16	3.23 - 3.76
DIGIT 1 TIP-CROTCH	17	2.04	.16	1.78 - 2.30
HAND LENGTH	18	6.88	.22	6.52 - 7.23
DIGIT 2 TIP-CROTCH	19	2.71	.15	2.47 - 2.95
DIGIT 3 TIP-CROTCH	20	2.90	.15	2.73 - 3.22
DIGIT 4 TIP-CROTCH	21	2.82	.14	2.59 - 3.05
DIGIT 5 TIP-CROTCH	22	2.16	.16	1.90 - 2.43

UNITS ARE INCHES

TABLE B-5

REGULAR MEDIUM

THE RANGE FOR HAND CIRC. METACARP 7.25 - 8.00
 THE RANGE FOR HAND LENGTH 7.25 - 8.00

N = 10 TARIFF PERCENTAGE = 6.85%

	VAR NO	W10-SIZE VALUE	SZ-50	RANGE TO BE ACCOMMODATED
HAND CIRC. METACARP	1	7.63	.22	7.27 - 7.98
HAND BREADTH, META	2	3.19	.11	3.00 - 3.37
DIGIT 1 JOINT CIRC	3	2.52	.13	2.30 - 2.73
DIG 2 DST JNT CIRC	4	1.95	.11	1.76 - 2.14
DIG 3 DST JNT CIRC	5	1.96	.11	1.77 - 2.15
DIG 4 DST JNT CIRC	6	1.86	.11	1.68 - 2.04
DIG 5 DST JNT CIRC	7	1.68	.12	1.49 - 1.87
DIG 2 PR JNT CIRC	8	2.36	.12	2.17 - 2.56
DIG 3 PR JNT CIRC	9	2.43	.13	2.22 - 2.64
DIG 4 PR JNT CIRC	10	2.27	.12	2.06 - 2.47
DIG 5 PR JNT CIRC	11	1.97	.12	1.77 - 2.17
WRIST CIRC	12	6.29	.28	5.82 - 6.76
CROTCH 1 HEIGHT	13	2.58	.20	2.24 - 2.92
CROTCH 2 HEIGHT	14	4.28	.17	3.99 - 4.57
CROTCH 3 HEIGHT	15	4.21	.17	3.93 - 4.50
CROTCH 4 HEIGHT	16	3.74	.16	3.47 - 4.01
DIGIT 1 TIP-CROTCH	17	2.32	.16	2.06 - 2.59
HAND LENGTH	18	7.63	.22	7.27 - 7.98
DIGIT 2 TIP-CROTCH	19	2.85	.15	2.61 - 3.09
DIGIT 3 TIP-CROTCH	20	3.29	.15	3.05 - 3.54
DIGIT 4 TIP-CROTCH	21	3.06	.14	2.86 - 3.31
DIGIT 5 TIP-CROTCH	22	2.32	.16	2.05 - 2.58

UNITS ARE INCHES

TABLE B-6

REGULAR LARGE

THE RANGE FOR HAND CIRC, METACARP 8.00 - 8.75
 THE RANGE FOR HAND LENGTH 7.25 - 8.00

N = 78 TARIFF PERCENTAGE = 53.42%

	VAR	NID-SIZE	SZ-SO	RANGE TO BE
	NO	VALUE		ACCOMMODATED
HAND CIRC, METACARP	1	8.38	.22	8.02 - 8.73
HAND BREADTH, META	2	3.48	.11	3.29 - 3.66
DIGIT 1 JOINT CIRC	3	2.64	.13	2.43 - 2.85
DIG 2 DST JNT CIRC	4	2.07	.11	1.89 - 2.26
DIG 3 DST JNT CIRC	5	2.10	.11	1.91 - 2.28
DIG 4 DST JNT CIRC	6	1.90	.11	1.79 - 2.16
DIG 5 DST JNT CIRC	7	1.80	.12	1.61 - 1.99
DIG 2 PR JNT CIRC	8	2.50	.12	2.30 - 2.69
DIG 3 PR JNT CIRC	9	2.56	.13	2.35 - 2.77
DIG 4 PR JNT CIRC	10	2.38	.12	2.18 - 2.59
DIG 5 PR JNT CIRC	11	2.89	.12	1.89 - 2.29
WRIST CIRC	12	6.78	.20	6.31 - 7.25
CROTCH 1 HEIGHT	13	2.63	.20	2.29 - 2.96
CROTCH 2 HEIGHT	14	4.28	.17	3.99 - 4.56
CROTCH 3 HEIGHT	15	4.21	.17	3.93 - 4.49
CROTCH 4 HEIGHT	16	3.77	.16	3.51 - 4.04
DIGIT 1 TIP-CROTCH	17	2.27	.16	2.01 - 2.54
HAND LENGTH	18	7.63	.22	7.27 - 7.98
DIGIT 2 TIP-CROTCH	19	2.91	.15	2.67 - 3.16
DIGIT 3 TIP-CROTCH	20	3.31	.15	3.06 - 3.55
DIGIT 4 TIP-CROTCH	21	3.11	.14	2.88 - 3.34
DIGIT 5 TIP-CROTCH	22	2.37	.16	2.11 - 2.64

UNITS ARE INCHES

TABLE B-7

REGULAR X-LARGE

THE RANGE FOR HAND CIRC. METACARP 8.75 - 9.50
 THE RANGE FOR HAND LENGTH 7.25 - 8.00

N = 15 TARIFF PERCENTAGE = 10.27%

	VAR NO	MID-SIZE VALUE	SZ-50	RANGE TO BE ACCOMMODATED
HAND CIRC. METACARP	1	9.12	.22	8.77 - 9.48
HAND BREADTH, META	2	3.77	.11	3.58 - 3.95
DIGIT 1 JOINT CIRC	3	2.76	.13	2.55 - 2.98
DIG 2 DST JNT CIRC	4	2.29	.11	2.01 - 2.38
DIG 3 DST JNT CIRC	5	2.23	.11	2.04 - 2.42
DIG 4 DST JNT CIRC	6	2.09	.11	1.91 - 2.28
DIG 5 DST JNT CIRC	7	1.93	.12	1.74 - 2.12
DIG 2 PR JNT CIRC	8	2.63	.12	2.44 - 2.83
DIG 3 PR JNT CIRC	9	2.69	.13	2.48 - 2.99
DIG 4 PR JNT CIRC	10	2.50	.12	2.29 - 2.70
DIG 5 PR JNT CIRC	11	2.22	.12	2.02 - 2.42
WRIST CIRC	12	7.27	.28	6.88 - 7.74
CROTCH 1 HEIGHT	13	2.68	.20	2.34 - 3.01
CROTCH 2 HEIGHT	14	4.27	.17	3.98 - 4.56
CROTCH 3 HEIGHT	15	4.21	.17	3.92 - 4.49
CROTCH 4 HEIGHT	16	3.80	.16	3.54 - 4.07
DIGIT 1 TIP-CROTCH	17	2.23	.16	1.96 - 2.49
HAND LENGTH	18	7.63	.22	7.27 - 7.98
DIGIT 2 TIP-CROTCH	19	2.98	.15	2.74 - 3.22
DIGIT 3 TIP-CROTCH	20	3.33	.15	3.08 - 3.57
DIGIT 4 TIP-CROTCH	21	3.14	.14	2.91 - 3.37
DIGIT 5 TIP-CROTCH	22	2.43	.16	2.16 - 2.69

UNITS ARE INCHES

TABLE B-8

LONG LARGE

THE RANGE FOR HAND CIRC, METACARP 8.00 - 8.75
 THE RANGE FOR HAND LENGTH 8.00 - 8.75

N = 15 TARIFF PERCENTAGE = 10.27%

	VAR NO	HIG-SIZE VALUE	SZ-50	RANGE TO BE ACCOMMODATED
HAND CIRC, METACARP	1	8.38	.22	8.02 - 8.73
HAND BREADTH, META	2	3.49	.11	3.31 - 3.68
DIGIT 1 JOINT CIRC	3	2.71	.13	2.50 - 2.93
DIG 2 DST JNT CIRC	4	2.13	.11	1.94 - 2.31
DIG 3 DST JNT CIRC	5	2.15	.11	1.96 - 2.34
DIG 4 DST JNT CIRC	6	2.00	.11	1.82 - 2.18
DIG 5 DST JNT CIRC	7	1.83	.12	1.64 - 2.02
DIG 2 PR JNT CIRC	8	2.56	.12	2.37 - 2.76
DIG 3 PR JNT CIRC	9	2.65	.13	2.44 - 2.86
DIG 4 PR JNT CIRC	10	2.48	.12	2.27 - 2.68
DIG 5 PR JNT CIRC	11	2.17	.12	1.97 - 2.37
WRIST CIRC	12	6.93	.28	6.46 - 7.40
CROTCH 1 HEIGHT	13	2.88	.20	2.54 - 3.22
CROTCH 2 HEIGHT	14	4.68	.17	4.40 - 4.97
CROTCH 3 HEIGHT	15	4.59	.17	4.31 - 4.88
CROTCH 4 HEIGHT	16	4.05	.16	3.79 - 4.32
DIGIT 1 TIP-CROTCH	17	2.51	.16	2.25 - 2.77
HAND LENGTH	18	8.38	.22	8.02 - 8.73
DIGIT 2 TIP-CROTCH	19	3.12	.15	2.88 - 3.36
DIGIT 3 TIP-CROTCH	20	3.64	.15	3.39 - 3.89
DIGIT 4 TIP-CROTCH	21	3.40	.14	3.17 - 3.63
DIGIT 5 TIP-CROTCH	22	2.59	.16	2.32 - 2.85

UNITS ARE INCHES

TABLE B-9

LONG X-LARGE

THE RANGE FOR HAND CIRC, METACARP 8.75 - 9.50
 THE RANGE FOR HAND LENGTH 8.00 - 8.75

N = 17 TARIFF PERCENTAGE = 11.64%

	VAR NO	NO-SIZE VALUE	SZ-SB	RANGE TO BE ACCOMMODATED
HAND CIRC, METACARP	1	9.13	.22	8.77 - 9.48
HAND BREADTH, META	2	3.79	.11	3.60 - 3.97
DIGIT 1 JOINT CIRC	3	2.84	.13	2.62 - 3.05
DIG 2 DST JNT CIRC	4	2.25	.11	2.06 - 2.44
DIG 3 DST JNT CIRC	5	2.29	.11	2.10 - 2.47
DIG 4 DST JNT CIRC	6	2.12	.11	1.93 - 2.30
DIG 5 DST JNT CIRC	7	1.95	.12	1.76 - 2.14
DIG 2 PR JNT CIRC	8	2.70	.12	2.50 - 2.89
DIG 3 PR JNT CIRC	9	2.70	.13	2.57 - 2.99
DIG 4 PR JNT CIRC	10	2.59	.12	2.39 - 2.80
DIG 5 PR JNT CIRC	11	2.30	.12	2.10 - 2.50
WRIST CIRC	12	7.42	.20	6.95 - 7.89
CROTCH 1 HEIGHT	13	2.93	.20	2.59 - 3.26
CROTCH 2 HEIGHT	14	4.60	.17	4.39 - 4.97
CROTCH 3 HEIGHT	15	4.59	.17	4.31 - 4.87
CROTCH 4 HEIGHT	16	4.00	.16	3.82 - 4.35
DIGIT 1 TIP-CROTCH	17	2.46	.16	2.20 - 2.72
HAND LENGTH	18	8.30	.22	8.02 - 8.73
DIGIT 2 TIP-CROTCH	19	3.18	.15	2.94 - 3.43
DIGIT 3 TIP-CROTCH	20	3.66	.15	3.41 - 3.90
DIGIT 4 TIP-CROTCH	21	3.43	.14	3.20 - 3.66
DIGIT 5 TIP-CROTCH	22	2.64	.16	2.38 - 2.91

UNITS ARE INCHES

REFERENCES

Barter, J.T. and M. Alexander, 1956, A Sizing System for High Altitude Gloves, WADC Technical Report 56-599 (AD 110 589), Wright Air Development Center, Air Research and Development Command, Wright-Patterson Air Force Base, Ohio.

Churchill, E., P. Kikta and T. Churchill, 1977, The AMRL Anthropometric Data Bank Library: Volumes I-V, AMRL-TR-77-1 (AD A047 314), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

Clauser, C.E., P.E. Tucker, J.T. McConville, E. Churchill, L.L. Laubach and J.A. Reardon, 1972, Anthropometry of Air Force Women, AMRL-TR-70-5 (AD 743 113) Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

Garrett, J.W., 1970a, Anthropometry of the Air Force Female Hand, AMRL-TR-69-26 (AD 710 202), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

Garrett, J.W., 1970b, Anthropometry of the Hand of Male Air Force Flight Personnel, AMRL-TR-69-42 (AD 709 883), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

Kennedy, K.W., 1986, A Collation of United States Air Force Anthropometry (U), AAMRL-TR-85-062, Harry G. Armstrong Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

McConville, J.T. and M. Alexander, November 1975, "Anthropometric Sizing Program for Oral-Nasal Oxygen Masks Based on 1967 U.S. Air Force Survey Data," Aviation, Space, and Environmental Medicine, 46:11, 1383-1389. (Also identified as AMRL-TR-75-51, AD A027 516.)

Robinette, K.M., T. Churchill and I. Tebbetts, 1981, Integrated Size Programs for U.S. Army Men and Women, Technical Report NATICK/TR-81/032 (AD A109 309), U.S. Army Natick Research and Development Laboratories, Natick, Massachusetts.

Robinette, K.M., G. Ervin and G.F. Zehner, 1986, Dexterity Testing of Chemical Defense Gloves, AAMRL-TR-86-021, Harry G. Armstrong Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.